

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* YONG WANG,  
JIANLI HU, YA-HUEI CHIN,  
ROBERT A. DAGLE and  
CHUNSHE CAO

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Appeal 2007-3236  
Application 10/076,880  
Technology Center 1700

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Decided: November 29, 2007

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Before EDWARD C. KIMLIN, BRADLEY R. GARRIS, and CATHERINE  
Q. TIMM, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

1 Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1, 5-23, 26, and 31-35. We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE and REMAND.

## I. BACKGROUND

The invention relates to a catalyst and the method of making the catalyst. Claims 1 are 5 are illustrative of the subject matter on appeal:

1. A catalyst comprising:

a metal oxide support;

a coating comprising zinc on the metal oxide support; and

palladium in contact with said coating;

wherein the catalyst possesses a volumetric productivity such that, when tested in a measurement in which the catalyst is placed in a reactor and exposed to premixed, vaporized water and methanol at a water to methanol ratio of 1.78, at 300°C, about 1 atm pressure and a contact time of 100 ms (for powders and crushed pellets) or 150 ms (for felts and foams), at least 10,000 ml H<sub>2</sub>/ml catalyst-hr is produced.

5. A method of making a catalyst, comprising the steps of:

providing a solid metal oxide support;

adding a solution comprising dissolved zinc to the solid metal oxide support, or adding a solid metal oxide support to a solution comprising dissolved zinc;

adding a base to increase pH; and

subsequent to at least a portion of the step of adding a base, depositing Pd.

The Examiner rejects the claims as follows:

1. Claims 1, 5-7, 9-15, 19, 20, 23, 26, and 33-35 under 35 U.S.C.

§ 102(e) as anticipated by or, in the alternative, under 35 U.S.C.

§ 103(a) as obvious over Wieland et al. (US 6,413,449 B1 issued Jul. 2, 2002);<sup>1</sup>

2. Claims 8, 17, 18, 21, 31, and 32 under 35 U.S.C. § 103(a) as unpatentable over Wieland; and
3. Claims 16 and 22 under 35 U.S.C. § 103(a) as unpatentable over Wieland in view of Feinstein et al. (US 4,177,219 issued Dec. 4, 1979).

Appellants request review of all the above rejections but they list the first two rejections as one. Appellants also present separate arguments under separate headings. We have considered the issues arising from the contentions for each of Appellants' groups of claims. We address those issues below, separately where required.

## II. DISCUSSION

### *A. The Rejection of the Method Claims Over Wieland*

We first focus on the rejection of method claims 5, 7-15 and 31-35 as either anticipated by or obvious over Wieland.

All of the method claims require a step of “adding a solution comprising dissolved zinc to the solid metal oxide support” or adding the support to such a solution (Claim 5). Appellants contend that Wieland does not describe “adding” a zinc solution to the support, but rather describes forming a zinc solution in-situ (Br. 4). The Examiner finds that Wieland discloses the claimed process in column 7, lines 5-13, 22-24, and 37-40, and

<sup>1</sup> While claims 23 and 26 are not listed in the statement of the rejection, they are discussed in the body of the rejection (Final Rejection 4; Answer 5). Appellants include claims 23 and 26 in their arguments against the rejection (Br. 3-4). The omission of these claims from the statement of rejection is, therefore, harmless error.

contends that in-situ dissolving, as described by Wieland, is a step of “immersing in solution” which is the same as adding the solution (Answer 4 and 9).

The issue arising from the contentions of the Appellants and the Examiner is: Does Wieland describe a method of making a catalyst including a step of “adding a solution comprising dissolved zinc” to a solid metal oxide support?

We answer this question in the negative.

There is no real dispute between the Examiner and the Appellants with regard to what Wieland teaches. Wieland describes a process of dispersing zinc oxide powder and a support material in water (Wieland, col. 7, ll. 4-9). To this dispersion of solid materials in water is added an acidic solution of a palladium compound (Wieland, col. 7, ll. 9-11). The dispersion is then neutralized with a base such as sodium carbonate, reduced with an aqueous reducing agent, filtered, washed, dried, calcined, and reduced in a hydrogen-containing gas (Wieland, col. 7, ll. 11-17). Alternatively, between the washing and drying steps, a carrier body is coated with the catalyst within the dispersion (Wieland, col. 7, ll. 22-28). According to Wieland,

A surprising feature of this procedure is that the palladium is also fully alloyed with the zinc . . . even though *no soluble zinc compound* that could be precipitated simultaneously together with the palladium compound *is added to the dispersion*. Obviously the zinc oxide added in the form of a finely divided powder is partially dissolved by the addition of the acidic noble metal [i.e., palladium,] solution. In the neutralization of the dispersion with sodium carbonate, palladium and the zinc that has passed into solution are then precipitated together on the zinc oxide as well as on the other support material.

(Wieland, col. 7, ll. 29-39 (emphasis added)). Wieland expressly states that “*no soluble zinc compound that could be precipitated simultaneously together with the palladium compound is added to the dispersion.*” (Wieland, col. 7, ll. 32-33 (emphasis added)). It is the addition of the acidic palladium solution to the dispersion containing solid zinc oxide that causes the passing of zinc into solution (Wieland, col. 9-11 and ll. 33-37).

We find that Wieland does not describe “adding a solution comprising dissolved zinc to the solid metal oxide support” as claimed. The word “adding,” as that word is used in the Specification (Specification 4: 3-25) and commonly used in the chemical arts, requires that a *pre-made* solution including dissolved zinc be mixed with the support material. Wieland does not “add” such a pre-made solution, the solution forms in-situ as a product of other things that are added.

With regard to obviousness, the Examiner advances no separate rationale supporting an obviousness rejection.

Therefore, we do not sustain the rejection of method claims 5, 7-15, and 31-35 either on the basis of anticipation or on the basis of obviousness.

The above being said, we remand this application for the Examiner for consideration of the question of whether it would have been obvious to one of ordinary skill in the art to add a solution containing dissolved zinc rather than form the solution in-situ. To answer this question, the Examiner should consider Wieland’s statement that “the palladium is also fully alloyed with the zinc . . . even though no soluble zinc compound . . . is added to the dispersion.” (Wieland, col. 7, ll. 29-33). This statement seems to imply that adding zinc solutions to form this type of catalyst would have been understood to be a viable alternative. But a conclusion of obviousness on this basis

requires consideration of what those of ordinary skill reading the reference knew with regard to adding zinc solution to catalysts of this type. The Examiner should consider the teachings of other prior art, and the knowledge of those of ordinary skill in the art in considering this question.

*B. The Rejection of the Catalyst Product Claims Over Wieland*

Of the claims rejected over Wieland, claims 1, 6, 17-21, 23, and 26 are directed to a catalyst. Of these claims, claim 1 is an independent claim. All the other claims, except claim 6, are dependent on claim 1. Claim 6 is a product-by-process claim dependent on process claim 5.

*1. Claim 6*

With regard to claim 6, the relevant issue has not been addressed by either the Examiner or Appellants. Because claim 6 is a product claim dependent on a method claim, it is in product-by-process form. The issue with regard to product-by-process claims is: Regardless of the process described in the reference for making the prior art product, does the prior art reference describe a product reasonably appearing to have the same or substantially the same composition and structure as the product arising from the claimed process?

It has long been held that “[i]f the product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.”

*SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1317 (Fed. Cir. 2006) (quoting *In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985)).

As noted in *In re Brown*:

[W]hen the prior art discloses a product which reasonably appears to be either identical with or only slightly different than a product claimed in a product-by-process claim, a rejection based

alternatively on either section 102 or section 103 of the statute is eminently fair and acceptable. As a practical matter, the Patent Office is not equipped to manufacture products by the myriad of processes put before it and then obtain prior art products and make physical comparisons therewith.

459 F.2d 531, 535 (CCPA 1972). “Where a product-by-process claim is rejected over a prior art product that appears to be identical, although produced by a different process, the burden is upon the applicants to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product.” *In re Marosi*, 710 F.2d 799, 803 (Fed. Cir. 1983).

The process of Wieland is slightly different than that of claim 5: Wieland forms the zinc solution in-situ rather than pre-making the solution and adding it to the solid metal oxide support as claimed. However, Wieland expresses surprise that, even though a solution containing soluble zinc is not added, the palladium is fully alloyed with the zinc (Wieland, col. 7, ll. 29-33).

The Examiner should determine whether it is reasonable to conclude that the product of Wieland’s process is the same or substantially the same as the product formed by the claimed process given that the zinc alloys with the palladium just as it would if a zinc solution were added as claimed. If it is reasonable to so conclude, the burden shifts to Appellants to show that the claimed catalyst is unobviously different from the catalyst of Wieland.

*Marosi*, 710 F.2d at 803.

We note that the Wang Declaration as relied upon by Appellants does not address the question of whether the Wieland catalyst is unobviously different from that of claim 6. Unlike claim 1, claim 6 does not require any specified level of volume productivity. The Wang Declaration focuses on the

volume productivity, and does not present any evidence with regard to the effects of the processing difference on catalyst composition and structure.

We remand to the Examiner for analysis of the issues discussed above.

*2. Claims 1, 17-21, 23, and 26*

Turning to claim 1 and those claims depending on claim 1, the Examiner's rejection is on the basis that Wieland describes catalysts having the composition required by the claims, and that while Wieland does not disclose a volume productivity at the claimed process conditions, it is reasonable to conclude that the volume productivity is inherently within the range of the claims (Answer 3-4). Appellants contend that, as proven by the Wang Declaration (with the attached "Comparison of MeOH Steam Reforming Catalyst with U.S. Patent 6,413,449"), Wieland's catalyst does not inherently have the claimed productivity (Br. 3). The Examiner responds that "the evidence of non-obviousness is not commensurate in scope with the claim" because different amounts of palladium (Pd) are used for the prior art and the claimed catalyst referring to Table 1 of the "Comparison" document (Answer 8).

The Examiner has failed to adequately address the dispositive issue arising from the Wang Declaration. The relevant issue is: Have Appellants, in response to the Examiner's reasonable conclusion of inherency, provided sufficient evidence showing that, in fact, the catalyst of Wieland does not inherently have a hydrogen productivity of 10,000 ml H<sub>2</sub>/ml catalyst·hr? It is the answer to this question that determines whether Appellants have overcome the rejection by showing an unobvious difference between the claimed catalyst and the catalyst of Wieland. *See In re Best*, 562 F.2d 1252, 1255 (CCPA 1977) ("Where, as here, the claimed and prior art products are

identical or substantially identical, or are produced by identical or substantially identical processes, the PTO can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of his claimed product.”).

The key question is whether the evidence supports the statement in the Wang Declaration that the “Comparison” document “shows that the catalyst described in [Wieland], if tested according to conditions described in our specification (that is, at 300 °C and a mixture of water and methanol of 1.78, about 1 atm pressure and a contact time of 100 ms (or 150 ms)), would have a productivity that is substantially less than 10,000 ml H<sub>2</sub>/ ml catalystAhr [sic].” (Wang Declaration ¶ 2).

We remand the Application to the Examiner to consider the above issue in light of the following guidance.

Evaluation of whether the evidence supports the declaratory statement requires an evaluation of the validity of the calculations in the “Comparison” document. To be probative, the calculations must reflect the productivity values that would be obtained if the actual tests on Wieland’s exemplified catalysts were conducted. It is, therefore, necessary to verify the validity of the methodology, logic, and assumptions underlying the calculations.

The “Comparison” document reports various volume productivities generally related to the examples of Wieland. In Section 1 of the “Comparison” document (entitled “*Analysis of Relevant Information from U.S. Patent 6,413,449*”), the author<sup>2</sup> calculates a theoretical maximum volume productivity for a catalyst in a reactor in which the methanol space velocity

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<sup>2</sup> The author of the “Comparison” document is not stated.

(liquid hourly space velocity or LHSV) is  $5 \text{ h}^{-1}$ . The author reports of value of 8310 ml  $\text{H}_2$ / ml catalyst·h.

The Examiner should note that this value of 8310 ml  $\text{H}_2$ / ml catalyst·h is not directly probative on the question of whether Wieland describes a catalyst with a volume productivity of at least 10,000 ml  $\text{H}_2$ / ml catalyst·h at the claimed process conditions. There is no evidence that the theoretical productivity the author calculates for 5 LHSV methanol is equivalent to a productivity at the claimed conditions including 100 ms or 150 ms contact times at a temperature of 300 °C.

Section 2 of the “Comparison” document, under the heading “*From Wieland’s Patent,*” calculates a productivity based upon a 57% conversion of methanol to hydrogen gas. Again, this value has not been shown to be equivalent to hydrogen productivity at the claimed conditions of 100 ms or 150 ms contact time and 300 °C.

The next subsection, “*From Our Patent Application,*” does not report any productivity values for Wieland’s catalyst and, therefore, is also not directly relevant to the question of whether any of Wieland’s catalysts have a volume productivity within the claimed range. It, however, is somewhat relevant to claim 26 on the question of specific activity of the catalyst. But, again, there is no evidence that the conditions of the calculation reflect the conditions required by the claim, particularly the 25 ms contact time, 1.8 steam-to-carbon ratio, and pressure drop.

The next two subsections, the “*Wieland’s Catalytic Hydrogen Productivity at 150 ms*” subsection and the “*Wieland’s Catalyst Hydrogen Productivity at 100 ms*” subsection, are more relevant. However, the chemical engineering theories and assumptions behind those calculations are unstated.

Moreover, many steps of the calculations are omitted. The Examiner should determine whether enough information is present to determine whether the calculations result in hydrogen productivity values sufficiently close to the actual values that would be obtained through testing to be probative on the question at hand: The question is whether Wieland describes a catalyst having a volume productivity for hydrogen within the claimed range when tested at the claimed conditions.

We specifically bring to the Examiner's attention the statement in the "Comparison" document that "150 ms is equivalent to total GHSV=24,000h<sup>-1</sup>, which is total feed rate of 24,000 ml/ml catalyst.h" and the similar statement for 100 ms in the next subsection. Appellants seem to be referring to total GHSV<sub>(methanol and water)</sub> at 300 °C, but it is unclear that this is the case. Such is not stated. Nor is it stated how this equivalency was obtained. Nor is the theory upon which it based given. However, it appears that the author is equating the space velocity at the inlet with the reciprocal of the contact time of the fluid (also known as the residence time). The Examiner should determine whether such an assumption is valid (or whether it can be even be determined whether it is valid with the information of record) for the catalyst of Wieland under the conditions of methanol reforming. According to *An Introduction to Chemical Engineering Kinetics & Reactor Design*,

The space time [, i.e., the reciprocal of space velocity,] is not necessarily equal to the average residence time of an element of fluid in the reactor. Variations in the number of moles on reaction as well as variations in temperature and pressure can cause the volumetric flow rate at arbitrary points in the reactor to differ appreciably from that corresponding to inlet conditions. Consequently, even though the reference conditions may be taken as those prevailing at the reactor inlet, the space time need not be

equal to the mean residence time of the fluid. The two quantities are equal only if *all* of the following conditions are met.

1. Pressure and temperature are constant throughout the reactor.
2. The density of the reaction mixture is independent of the extent of reaction. For gas phase reactions this requirement implies that there can be no change in the number of moles on reaction. In terms of equation 3.1.45, we require that  $\delta = 0$ .
3. The reference volumetric flow rate is evaluated at reactor inlet conditions.

Charles G. Hill, Jr., *An Introduction to Chemical Engineering Kinetics & Reactor Design*, 256 (1977).<sup>3</sup>

We, therefore, remand the Application to the Examiner for a determination of whether the “Comparison” document provides sufficient evidence supporting the assertion in the Declaration that Wieland’s catalysts would not have volume productivities within the claimed range of at least 10,000 H<sub>2</sub>/ ml catalyst·h when exposed in a reactor to premixed, vaporized water and methanol at a water to methanol ratio of 1.78, at 300 °C, about 1 atm pressure, and a contact time of 100 ms or 150 ms.

As Appellants rely upon the Declaration to overcome the rejection of claims 19, 20, and 26 as well as the claim group of 1, 17, 18, 20, 21, and 23, we remand for a determination of the sufficiency of the showing with regard to the issues raised for those claim groupings as well.

*D. The Rejection of Claims 16 and 22 Over the Combination of Wieland and Feinstein*

The Examiner adds Feinstein as evidence that it would have been obvious to add ruthenium (Ru) to the catalyst of Wieland.

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<sup>3</sup> We append to this decision section 8.0.3.2 (pages 254 to 257) of Charles G. Hill, Jr., *An Introduction to Chemical Engineering Kinetics & Reactor Design* (1977).

With regard to claim 16, this claim is dependent on claim 5. As we discussed above, the Examiner's rejection of claim 5 was deficient. The rejection of claim 16 over Wieland in view of Feinstein relies upon Wieland in the same manner as the rejection of claim 5. Therefore, we do not sustain the rejection of claim 16 for the same reasons we do not sustain the rejection of the other method claims.

With regard to claim 22, this claim is ultimately dependent on claim 1 (through claims 17, 20, and 21). Moreover, the Examiner relies upon Wieland in the rejection of claim 22 in the same manner as for the rejection of claim 1. The record is not yet ripe for our review with regard to catalyst claims 1, 17, 20, and 21, and for this reason we have remanded the Application to the Examiner for further consideration of the issues arising with regard to the rejection of those claims. Therefore, the time is also not ripe for review of the rejection of claim 22.

### III. DECISION

The decision of the Examiner to reject claims 5, 7-16, and 31-35 is reversed, but we remand the Application to the Examiner for further consideration of the issue of obviousness with regard to those claims. Because the issues are not ripe for our review with regard to the rejection of claims 1, 6, 17-23, and 26, we remand this Application to the jurisdiction of the Examiner for further consideration of the issues with regard to those claims.

REVERSED and REMANDED

Appeal 2007-3236  
Application 10/076,880

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enclosure

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